THE EXAMINATION OF THE URINE AND FECES OF SUSPECT TYPHOID-CARRIERS WITH A REPORT ON ELATERIN CATHARSIS *

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It is our purpose to present a brief study of the results of examination of 290 specimens of urine and 298 specimens of feces, and to discuss certain practical phases of the work in connection with the search for typhoid-carriers.

ELATERIN CATHARSIS

That many typhoid-carriers pass the typhoid bacillus intermittently has long been recognized, and it has been the common experience of bacteriologists that feces examinations are frequently negative even in known carriers. Hence, the opinion prevails that several specimens, collected over a period of considerable time, should be found negative before a suspect can be definitely discharged as negative, or a typhoid-carrier or convalescent pronounced definitely cured.

In a recent article by Dryer, Walker, and Gibson[1] particular attention is given to an improved method of technic, whereby a larger quantity of fecal material can be examined, thereby increasing the chances of securing positive results in cases in which the bacilli are sparse in number. The authors mentioned make use of actinic light to inhibit the growth of organisms other than typhoid and paratyphoid bacilli.

On the basis of the fact that postmortem examinations of typhoid patients commonly demonstrate the presence of typhoid bacilli in largest numbers in the small intestine, whereas they are seldom found in the colon, a plan was evolved in this laboratory of using, in carrier cases, a suitable cathartic to bring down the contents of the small intestine. The selection of such a cathartic involves two essential considerations: (1) The hydrogogue cathartic selected, must be sufficiently powerful to empty the bowels thoroughly and to bring down the contents of the small intestines, and (2) it must be devoid of antiseptic properties.

Elaterin appeared to meet both these requirements satisfactorily. It

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[1] Lancet, 1915, 1, p. 324.

was tried out experimentally, and its use adopted as routine procedure in the examination of typhoid-carriers in this laboratory. The dosage ordinarily given varies from 0.1 to 0.2 of a grain of elaterin. Given in the evening, it usually results in a copious bowel movement on the following morning. The first portion of the bowel movement, consisting of formed stool, is discarded. The last or liquid portion is retained for examination.

Our first experience in the use of elaterin was in connection with a restaurant epidemic, for which a waitress who proved to be a typhoid-carrier was responsible. In this case 3 successive specimens of

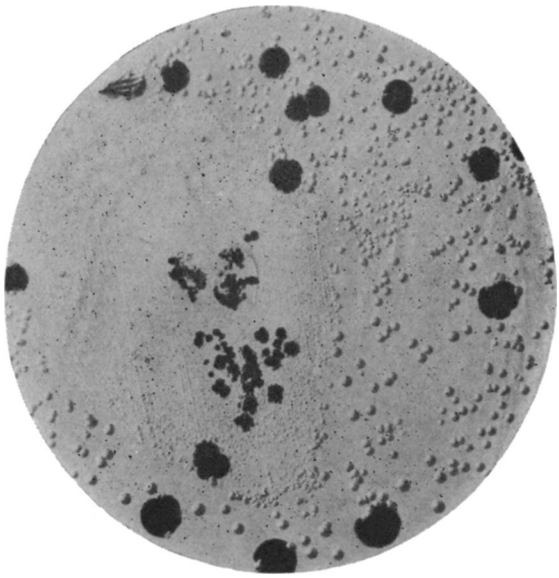

Fig. 1. Portion of an Endo plate inoculated with feces of a typhoid-carrier after elaterin catharsis, showing numeric relation between typhoid and colon colonies. Typhoid colonies are colorless; colon colonies are dark-red. The ratio of typhoid to colon colonies in this specimen was 31 to 1.

feces collected without the use of elaterin, were negative. Elaterin was administered prior to the collection of the fourth specimen, with the result that typhoid bacilli were isolated without difficulty in large numbers. In a second similar case, 2 negative specimens were obtained prior to the administration of elaterin, while the third specimen, obtained by the use of elaterin, yielded large numbers of typhoid bacilli. The first of these patients continued to yield positive elaterin stools for a number of weeks, until she was finally lost sight of.

The second one continued to yield positive elaterin stools for a period of three months, after which, under suitable treatment, the stools became negative. Since the adoption of the use of elaterin catharsis as a routine procedure in the examination of suspect carriers, 3 typhoid-carriers have been detected successively by examination of the first stool presented for test.

In one case only, which we shall designate as Carrier A, have we been able to make a detailed study of stools collected both with and without elaterin. The findings, however, with reference to the numeric relation existing between typhoid and colon colonies are interesting. Table 1 shows the approximate quantitative relationship between the two organisms with and without the use of a cathartic. These figures do not represent the bacteria content of any specified quantity of feces, but they indicate the ratio of typhoid colonies to colon colonies which existed on the plates selected as most suitable for counting. Up to the present time we have examined 23 stools from Carrier A. Nine specimens were collected by the use of elaterin, 13 without a cathartic, and 1 by the use of magnesium sulfate. Typhoid bacilli were isolated from all except one of the specimens obtained from this patient. This specimen was collected without elaterin.

TABLE 1

THE RATIO BETWEEN TYPHOID AND COLON BACILLI IN CARRIER A

Using Elaterin		Using No Cathartic		Using Magnesium Sulfate	
Typhoid	Colon	Typhoid	Colon	Typhoid	Colon
31	1	1	2	4	1
27	1	33	1		
125	1	1	1		
110	1	15	1		
156	1	18	1		
67	1	22	1		
41	1	5	1		
29	1	1	200		
3	1	1	100		
		1	300		
		0	500		
		1	150		
Total... 589	9	99	1,258	4	1
Average 65.4	1	1	12.7	4	1

It will be noted in Table 1 that the typhoid-colon ratio consistently favors the use of elaterin, the average with elaterin being 65.4 typhoid to 1 colon, and without elaterin, 1 typhoid to 12.7 colon. As judged by the typhoid-colon ratio, typhoid bacilli were 830.6 times more numerous in elaterin stools than in normal stools.

Figure 1 is representative of the appearance of the Endo plates made in the case of Carrier A from elaterin stools.

The findings thus far obtained, appear to justify the use of elaterin as a valuable adjunct to the technic of feces examination.

TECHNIC

Materials Necessary.—Endo's medium, Petri dishes, capillary pipets, and glass rods.

Endo's medium is prepared as described by Kenyoun and Deiter.[2] The agar is stored in 100-c.c. portions in bottles until immediately before use. When required the agar is melted in an Arnold sterilizer, and sodium carbonate or acid, as determined by the titration, is added. In our experience, it is usually necessary to add from 0.5 to 0.9 c.c. of a 2.5% solution of anhydrous sodium carbonate. To all bottles we add, in addition to the sodium carbonate, 1 gram of crystallized lactose C. P., 5 c.c. of a 10% solution of crystallized sodium sulfite, and 0.7 to 0.9 c.c. of a half-saturated alcoholic solution of basic fuchsin. Seven or eight plates can usually be poured from one 100-c.c. bottle. After the plates have hardened they are ready for use.

The capillary pipets are made from glass tubing about 8 mm. in diameter. The capillary opening is about 2 mm. in diameter. A non-perforated rubber nipple supplies the needed suction.

The glass rods are bent at right angles, about 2 cm. from one end, into the form of an "L."

The glass rods and pipets are sterilized by boiling for 5 minutes before and after use.

Plating of Specimens.—When urine is examined, the specimen is centrifugated and the sediment used. If a hard specimen of feces must be accepted, an emulsion is made with sterile salt solution. Liquid feces are used without dilution. In examining urines 2 or 3 plates are necessary, and in examining feces 5 plates are necessary.

A capillary drop of liquid feces is placed on the first plate and thoroughly spread over the plate with the short arm of the L-shaped rod. The glass rod is then rubbed over each of the other plates in succession without further addition of feces. This process usually gives numerous discrete colonies on the last two or three plates. A control plate should invariably be inoculated with known typhoid and colon bacilli upon opposite halves of the plate. The plates are then incubated for 24 hours at 37 C. Suspicious typhoid-like colonies are picked off and planted in tubes containing 10 c.c. of plain broth, made according to the following formula: Peptone—2 gm., meat extract—1.5 gm., salt—0.5 gm., water—100 c.c.

It is our practice to pick 10 colonies, if the number of suspicious colonies is 10 or more. In case fewer than 10 suspicious colonies are present, the entire number are picked. If no suspicious colonies are present, the test is discontinued at this point as negative. A known culture of typhoid bacilli is at the same time planted in several broth tubes as a control.

After an incubation of from 12 to 24 hours at 37 C., the cultures are examined. Tubes showing (1) scum or pellicle, and (2) heavy precipitate at bottom, are discarded. The typhoid bacillus is light and moves quickly on shaking (compare with control).

[2] Am. Jour. Pub. Health, 1912, 2 (O. S., 8), p. 979.

Macroscopic Agglutination Test with Typhoid Bacilli.—One capillary drop of antityphoid serum of about 1:1,000 titer is added to each tube. The tubes are placed in the incubator at 37 C. for 15 minutes. If no agglutination occurs in the control tube in this time, another drop is added to all the tubes and so on until a typical agglutination occurs in the control tube. If typical agglutination, comparable with that of the control, occurs in other than the control tubes, the presence of typhoid bacilli is indicated. The macroscopic agglutination test is then confirmed by removing a loopful of the agglutinated culture and examining it microscopically upon a hanging-drop slide.

Diagnostic Points.—Positive macroscopic and microscopic agglutination tests with typhoid bacilli are sufficient basis for the detention of the suspect carrier.

Confirmatory Tests: (1) The organism must be motile in young broth culture. (2) It must be a bacillus and must be gram-negative. (3) It produces typical dew-drop colonies on Endo's medium. (4) In litmus milk it produces slight alkalinity in 24 hours, and slight acidity after 48 hours, with coagulation in about one week. (5) In dextrose broth it produces acidity but no gas. (6) In lactose broth it produces no acidity or slight acidity without gas. (7) On Russell's medium it grows with unchanged surface and red color in the deep portions. (8) In Dunham's peptone it produces no indol.

Prior to the examination of feces and urine, it is usually advisable to make agglutination tests of the blood with typhoid bacilli. Cases showing positive reactions, as well as those giving suspicious typhoid histories, should be tested repeatedly for typhoid bacilli in the urine and feces before being discharged as negative.

Tests for typhoid bacilli in urine should be preceded by a chemical test for formaldehyd, which appears in urine as a result of the administration of hexamethylenamin, and which effectually prevents the isolation of typhoid bacilli from the urine.

THE EFFECT OF LACTOSE BILE "ENRICHMENT"

The use of lactose peptone bile as an enrichment medium for the detection of colon bacilli in water and sewage was first recommended by Jackson.[3] It has since been demonstrated that its effect is an inhibition rather than an acceleration of the growth of the organism. Its value depends on the fact that it probably inhibits the growth of other organisms more strongly than it does that of the colon bacillus, its inhibition of the colon bacillus being probably not sufficient to prevent the latter's detection.

The use of lactose bile medium has also been recommended in the examination of water supplies for typhoid bacilli. We tried out this medium over a period of 2 years, in connection with our routine examination of feces and urine for typhoid bacilli.

The 290 specimens of urine and the 298 specimens of feces here reported were plated directly on Endo's medium in the usual way. A second portion of each specimen was inoculated into lactose peptone bile, consisting of ox

[3] Jour. Infect. Dis., 1907, Suppl. 3, p. 30.

bile containing 1% of peptone and 1% of lactose. The bile inoculations were grown for 48 hours at 37 C., and then material from a portion of the bile culture was inoculated upon Endo's medium, by technic similar to that of the direct inoculations.

Table 2 shows definitely the inhibiting effect of the bile medium on the typhoid bacillus. In fact, in only one case, a urine examination, was the organism isolated from the bile when the direct plate was negative. This, in view of the other findings, we are inclined to attribute to an error in the technic of the direct examination. In the case of 8 specimens of urine and 38 specimens of feces, the organism isolated from the direct plates was lost in passage through the lactose bile. In only 2 specimens of feces and 1 of urine were the organisms isolated both from the bile medium and the direct plates. The total number of specimens of urine and feces found positive on direct plating was 50. The total number of specimens of urine and feces found positive after bile enrichment was 5.

With reference to the influence of a soft stool upon the positive result, it will be seen from the table that 21 elaterin stools were positive and 7 naturally soft stools were positive, whereas only 2 hard stools were positive. These figures added to our later results give totals as follows:

Elaterin stools positive	35
Soft stools without elaterin positive	18
Hard stools positive	4

As is evident from the quantitative results of the platings, typhoid bacilli are commonly much more numerous in soft, or diarrheal, stools than in formed stools. Therefore, a carrier is probably most infectious while he is in a diarrheal condition, and least infectious, or possibly not at all infectious, in the absence of diarrhea. This circumstance offers at least a partial explanation of the intermittent infectivity of many carriers.

With reference to the effect of hexamethylenamin, administered by mouth, upon the urinary typhoid-carriers, we may add that we have not been able to demonstrate typhoid bacilli in a specimen of urine which gave a reaction for formalin, altho we have examined at least one urinary carrier in our series.

SUMMARY AND CONCLUSIONS

The use of elaterin catharsis is of material assistance in the examination of the feces of suspect typhoid-carriers.

TABLE 2

RESULTS OF EXAMINATION OF URINE AND FECES FOR TYPHOID BACILLI WITH AND WITHOUT LACTOSE BILE ENRICHMENT

Specimens Positive by One or Both Methods. Specimen Number	First Portion, Plated Directly on Endo Medium		Second Portion, Grown in Lactose Bile 48 Hours and Plated on Endo Medium		Remarks
	Urine	Feces	Urine	Feces	
66	+	—	..	..	
160	+	—	+	—	
698	..	..	..	+	
722	+	—	—	—	
724	—	+	—	—	Elaterin
784	—	+	—	—	Elaterin
795	—	+	—	—	Elaterin
799	—	+	—	—	Elaterin
801	—	+	—	—	Elaterin
807	—	+	—	—	Elaterin
819	—	+	—	—	Elaterin
820	+	+	—	—	Elaterin
827	—	+	—	—	
828	—	+	—	—	Elaterin
830	+	+	—	—	
841	—	+	—	—	Elaterin
846	—	+	—	—	
849	+	+	—	—	Elaterin
855	+	—	—	—	
878	—	+	—	—	Elaterin
879	+	+	—	—	
900	—	+	..	—	
901	..	+	..	—	Elaterin
904	—	+	—	—	Elaterin
911	—	+	—	—	Soft
917	—	+	—	—	Soft
3	—	+	—	—	Soft
11	—	+	—	—	Elaterin
19	—	+	..	..	Hard
23	—	+	..	—	Elaterin
37	—	+	—	—	
46	—	+	—	+	
47	—	+	—	—	Soft
58	—	+	—	—	
67	—	+	—	—	Elaterin
82	—	+	—	—	
91	—	+	—	—	Elaterin
105	+	+	—	—	Soft
116	+	+	—	+	Soft
127	—	+	—	—	Elaterin
135	—	+	..	—	Elaterin
148	—	+	+	—	Soft
162	—	+	—	—	Elaterin
189	—	+	..	—	
657	—	+	—	—	
Total negative by both methods....	244*	241	244	241	
Totals (a) Positive.....	10	40 {21 elaterin; 7 soft....; 2 hard...}	2	3	
(b) Negative.....	277	246	284	282	
Total number of specimens.....	287	286	286	285	

* Formaldehyde present in 5

The value of a negative finding in the feces of a given typhoid-carrier suspect is enhanced by the use of elaterin.

The use of Endo plates, prepared according to the method of Kenyoun and Deiter, constitutes, in our experience, the most satisfactory practical technic for the examination of urine and feces for typhoid bacilli.

The effect of lactose peptone bile "enrichment," when used in the attempt to isolate typhoid bacilli from urine and feces, is that of inhibition of the growth of the typhoid bacillus. As a rule, typhoid organisms that are demonstrable by direct plating are lost by passage through lactose bile.

A diarrheal state on the part of the suspect greatly increases the chances of isolating the typhoid bacillus from the stool.

The infectivity of typhoid-carriers in whom the organism is carried by the feces, is greatly enhanced by the presence of a diarrheal condition, and is in all probability small, or possibly negligible, in the absence of diarrhea.

Our experience with the administration of hexamethylenamin to urinary typhoid-carriers indicates that typhoid bacilli are not demonstrable in the urine after recent administration of this drug.